GRUMMAN

MAGNETIC SPECTROMETER HE-15-S SORTIE PAYLOAD Volume IV of VI

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Marshall Space Flight Center
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by

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OPERATIONS PLANNING SIMULATION

MODEL EXTENSION STUDY

FINAL REPORT

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PREPARED FOR

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PREPARED BY

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PRODUCT SUPPORT DEPARTMENT

BETHPAGE, NEW YORK

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OPERATIONS PLANNING SIMULATION MODEL STUDY

(Contract NAS8-31102)

This is the final report of Contract NAS8-31102 and is submitted by the Grumman Aerospace Corporation, Bethpage, N. Y., in accordance with the terms and conditions of the contract.

The final report is packaged in six (6) volumes, entitled:

Volume I - Long Duration Exposure Facility (LDEF), Payload No. ST-01-A

Volume II - Life Sciences Shuttle Laboratory, Payload No. LS-09-S

Biomedical Experiments Scientific Satellite, Payload No. LS-02-A

Volume III - Dedicated Solar Sortie Mission (DSSM), Payload No. SO-01-S

Volume IV - Magnetic Spectrometer, Payload No. HE-15-S

Volume V - Mariner Jupiter Orbiter (MJO), Payload No. PL-12-A

Volume VI - Expanded Functional Flows and Descriptions

SUMMARY

I Study Objective

The objective of the Study was to evaluate the Launch Site Facility Requirements Data Sheets for selected Automated and Sortie Payloads.

The Study achieved the objective by:

- o Expanding the NASA launch site Level 0 functional flow activities to a depth required to identify payload launch site facility and support requirements (Volume VI contains the generic functional flow activities for Automated and Sortie payloads).
- o Conducting analyses of the payload definitions contained in the Level B Data issued by SSPD from the launch site ground processing viewpoint.
- o Processing the payloads through the expanded functional flow activities, and identifying the launch site facility and support requirements.
- o Comparing the generated requirements with those contained in the Launch Site Facility Requirements Data Sheets.

II Study Recommendations

Recommendations from the Study include:

- o Expansion and revision as appropriate of the Level B Data (SSPD) to define in detail the payload ground requirements, based upon the launch site functional flow activities, as well as performing Level II (not Level III) integration at the launch site.

Specific data sheets involved are:

- On-Orbit Checkout/Monitor/Control Equipment (Data Sheet No. A-9 and A-12)
- SKETCHES (Data Sheets No. A-10, S-5, and S-6), with emphasis on the configurations at launch site arrival and installed in Orbiter cargo bay.
- Interface Diagrams (Data Sheet No. S-7) showing the interfaces for monitoring and checkout during launch site ground processing.
- Data and Communications Checkout and Deployment Support/On-orbit Operations Support (Data Sheets No. A-14, A-15, S-19, and S-20).
- Launch/Landing Support Requirements (Data Sheets No. A-18 and S-22).
- Ground Facility Requirements (Data Sheets No. A-19 and S-23).
- Ground Environmental Limits (Data Sheets No. A-20 and S-24).

II Study Recommendations (Cont'd.)

- o Definition and descriptions to Level 4 or 5 of the launch site functional flow activities.
- o Investigation of payload ground requirements at the launch site which are identified as cost drivers for ground processing in this report.

III Future Investigative Areas

Cost effective processing of payloads at the launch site requires further studies and analyses. One area which would provide fruitful results is the generation of detail scenarios of representative payloads by disciplines for Payload Working Groups approval/modification. These detail scenarios would include the ground processing for:

- o Block 1.0 Activities - Payload Premission Processing
- o Block 2.0 Activities - Orbiter/Payload Integration and Checkout
- o Block 3.0 Activities - Prelaunch and Launch Operations
- o Block 4.0 Activities - Recovery Operations
- o Block 5.0 Activities - Post Mission Processing

Descriptions and required outline drawings would be provided to define in detail such ground functions and configurations as:

- o Payload and associated ground control and support equipment launch site arrival configurations, transportation and environmental modes, and arrival servicing and inspection/monitoring requirements.
- o Payload calibration
- o Monitoring
- o Checkout
- o Servicing
- o Intra-launch site transportation

The Grumman Aerospace Corporation would be pleased to assist the NASA/MSFC in performing additional studies and analyses to implement effective payload ground processing.

MAGNETIC SPECTROMETER (HE-15-S)

SORTIE PAYLOAD

Functional Flow Descriptions and Payload

Requirements for Ground and Launch Support Facilities

1.0 INTRODUCTION

Level B data for the Magnetic Spectrometer (MS) payload includes a requirement to continuously cryogenically cool the dewar cryostat while at the launch and landing sites. This requirement is contained in Data Sheet #S-23b, in column 8, entitled Special Handling. A brief consideration of this requirement indicates that the cryostat/magnet dewar assembly (HE 150) may be ruined if its normal temperature of around 4°K is permitted to rise above 18°K even when the unit is in a dormant mode or in a transport/storage condition.

The problems generated by this requirement in processing the Magnetic Spectrometer through the launch site functional flow are indicated below.

Block 1.0 Payload Premission Processing

- o The basic problem is the task of transporting the GSE LHe Conditioning Equipment, the GSE LHe dewar supply, and associated monitoring equipment with each movement of the Magentic Spectrometer (MS). The standard functional flow processing involves the following MS transfers upon arrival at launch site:
  - From MS transport aircraft to temporary storage
  - From temporary storage to receiving area of PPF
  - From receiving area to checkout area of PPF
  - From checkout area of PPF to OPF.
- o Processing costs are time-dependent; that is, the longer the MS takes to complete Premission Processing the higher the cost. These costs involve principally the amount of LHe required to replace boil-off, the personnel required to operate the GSE LHe Conditioning Equipment, and personnel to man the monitoring equipment.

Block 2.0 Orbiter/Payload Integration and Checkout

- o Requirement for constant monitoring of the HE 150 Dewar.
- o Availability to reservice the dewar with a portable source of LHe.
- o A hazardous condition could exist if a heat leak developed dur to insulation damage.
- o Once installed in the cargo bay, access becomes more difficult, should reservicing be required.

Block 3.0 Pre-Launch and Launch Operations

- o Access required to Orbiter Cargo Bay during Orbiter movements which include:
  - Tow from OPF to mate with boosters in VAB.
  - Installation of Shuttle on Mobile Launch Platform (MLP).
  - Movement of MLP from VAB to launch pad.
- o Transfer of LHe GSE during above processing flow.
- o Transfer/operation of monitoring equipment during above processing which also involves remote monitoring via Orbiter RF link.

2.0 After consideration of the above problems associated with processing the MS through the standard launch site functional flow, the Study recommends a revised functional flow for MS launch site processing. For Study purposes, this revised flow is termed the short flow, and its overview description follows:

Block 1.0 Payload Premission Processing

After arrival by aircraft, the MS is moved to the PPF where only the Orbiter Cabin equipment (HE 158, Control/Display Assembly) is given an interface verification test, using the Orbiter Simulator and MS GSE to simulate the remainder of the MS hardware.

From the PPF, the MS (less HE 158) is moved to the pad for vertically loading into Orbiter. The HE 158 assembly is transported to the OPF.

Block 2.0 Orbiter/Payload Integration and Checkout

The HE 150, Control/Display Assembly, of the MS is received and installed in the Payload Specialists Station (PSS). Using the PSS and GSE to simulate performance of the MS, interface verification tests are conducted after which the GSE is removed.

Block 3.0 Pre-Launch and Launch Operations

With the Orbiter in a vertical position and Cargo Doors open, the MS is installed, and interface connections mated. Launch verifications tests are performed, followed by final servicing operations and payload close-out. MS critical parameters are monitored continuously after MS is installed in Cargo Bay.

3.0 FUNCTIONAL FLOW DESCRIPTIONS AND PAYLOAD REQUIREMENTS FOR GROUND AND LAUNCH SUPPORT FACILITIES

3.1 Block 1.0 Activities - Payload Premission Processing

Level B data does not define a launch site arrival configuration for the Magnetic Spectrometer (MS). The Study uses the configuration shown in Figure 3-1 for ground processing. Descriptions of the arrival configuration follows:

- MS less HE-158: The Orbiter Cabin equipment (HE-158) has been separated from the other portions of the MS, since its processing flow has major differences from the other MS flow. The MS arrives cooled down, with appropriate monitoring displays being readable from outside the shipping container.

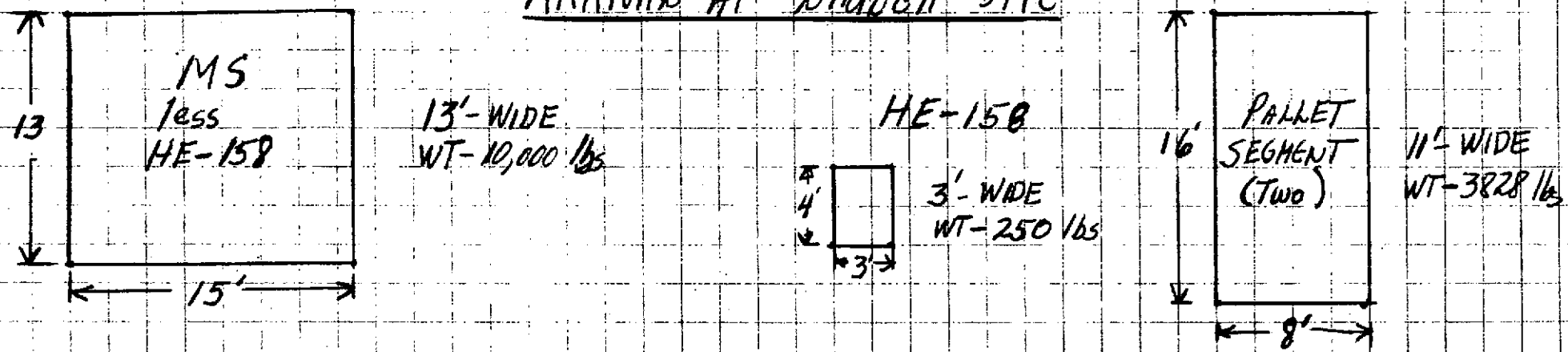
  Level B data does not define the time interval between LHe replenishment requirements in a ground environment. The Study assumes that, on a contingency basis, a supply of LHe for replenishment must be available at all times.

  The MS requires a pallet of 15 ft. long. For cost purposes, the Study assumes that the pallet would not be of dedicated design, but would use the standard Spacelab pallet segments which are about 10 ft. long. Thus, two standard Spacelab pallet segments are required. For air shipments, however, the MS mounted on two pallet segments is too large for the C5A aircraft, so the MS and pallet segments are shipped separately.

  Other approaches to the arrival configuration were considered briefly by the Study. One which may have a cost impact (degree not determined) involves the handling of cryostat/magnet dewar assembly (HE-150) separately from the rest of the MS. This approach would include Level III integration at the launch site (violation of ground rules) and MS design for ease of assembly/disassembly of HE-150 with the MS package. The advantage of handling HE-150 separately is that its time at the launch

MAGNETIC SPECTROMETER (MS) CONFIGURATION

ARRIVAL AT LAUNCH SITE



MS GSE

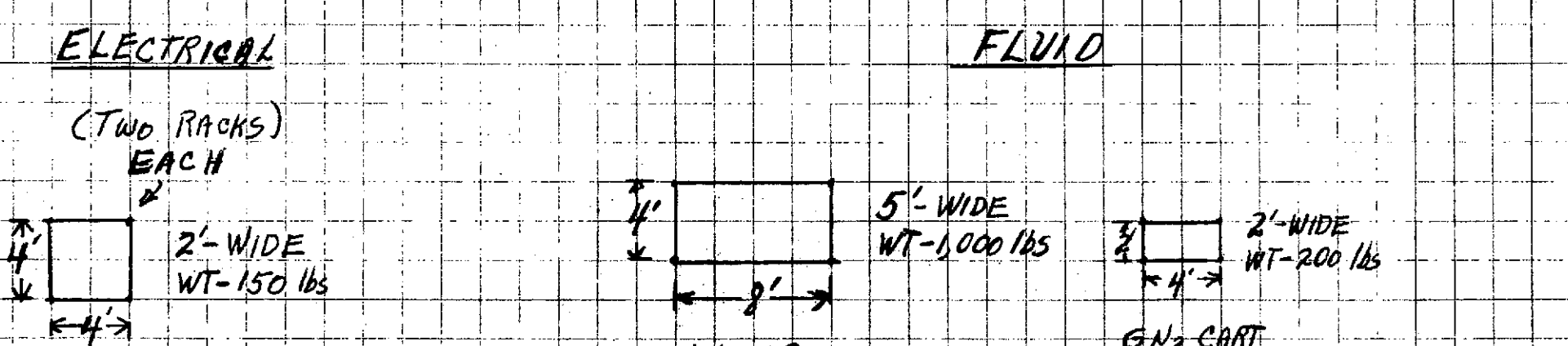


Figure 3-1

3.1 (Continued) (Block 1.0 -Cont'd.)

site would be reduced, thus a savings in LHe supply would be realized.

Block 1.1 - Receive and Inspect

Block 1.1.1 Unload MS (less HE-158), Two pallet Segments, and GSE LHe Cart from C5A Aircraft, Place on Flat Bed Trailer, Tow to PPF, and Unload at PPF

The above equipment arrives via C5A aircraft, is loaded on flat bed trailer, and transferred to the PPF. The MS (less HE-158) and GSE LHe cart are unloaded in the checkout area of the PPF, and the two pallet segments are unloaded in the receiving area of the PPF. The reason for using the two areas of the PPF is that, once unpacked, it is planned to move the MS (less HE-158) as little as possible so as to minimize the handling costs.

Ground and Launch Support Facility Requirements

Facility Requirements

- o PPF area
  - Checkout area - 30 ft. long, 30 ft. wide, and 20 ft. high (for flat bed trailer and unloading MS (less HE-158) and GSE LHe cart)
  - Receiving area - 18 ft. long, 24 ft. wide, and 18 ft. high (for two pallet segments)
- o Overhead crane, both Checkout and Receiving areas (12,000 lbs. capacity)
- o LHe supply (contingency) - at airfield, during tow, and at PPF.

Support Requirements

- o Air Force 463L Material Handling System (for unloading C5A aircraft).
- o Flat-bed Trailer (12,000 lbs. capacity, 28 ft. long, 10 ft. wide)
- o Tow tractor (for flat-bed trailer).
- o Hoisting Slings for MS, GSE LHe Cart, and Pallet Segment Shipping Containers.

Block 1.1.1 (Continued)

- o Operators for cranes, tow tractor, and 463L Material Handling System.
- o Riggers
- o Traffic Security Personnel
- o Procedures for monitoring MS parameters, and instructions for providing LHe requirements.
- o Procedure for unloading MS(less ~~Close~~ HE-158), GSE LHe Cart, and pallet segments.

Block 1.1.2 - Unload HE-158, Electrical GSE, GSE GN_2 Cart, and GSE X_e Cart from C5A, and Transfer to PPF.

The above equipment arrives via C5A aircraft, is loaded on flat-bed trailer, and transferred to the receiving area of the PPF, and unloaded.

Ground and Launch Support Facility Requirements

Facility Requirements

- o PPF receiving area 36 ft. long, 24 ft. wide, and 10 ft. high
- o GN_2 and X_e at both airfield and at PPF for contingency.

Support Requirements

- o Air Force 463L Material Handling System (for unloading C5A aircraft)
- o Flat-bed trailer (2,000 lbs. capacity, 20 ft. long, 10 ft. wide)
- o Two Tractor (for flat-bed trailer)
- o Fork lift truck
- o Operators for two tractor and fork lift trucks
- o Traffic Security personnel
- o Procedures for unloading above equipment

Block 1.1.3 Unpack and Inspect MS, pallet segments, and MS GSE

The MS (less HE-158) is removed from its shipping container, and placed on a movable holding fixture, and inspected to verify post-transportation integrity. The MS parameters are monitored.

The GSE LHe Cart is removed from its shipping container, placed on a movable dolly, and likewise inspected. The GSE LHe Cart is positioned for servicing the MS.

The above two activities are performed in the checkout area of the PPF.

In the receiving area of the PPF, similar functions are conducted on the HE-158, pallet segments, MS Electrical GSE, GSE GN_2 Cart, and GSE X_e cart.

Ground and Launch Support Facility Requirements

Facility Requirements

- o PPF area
  - Checkout area: 30 ft. long., 30 ft. wide, and 20 ft. high (for unpacking MS (less HE-158) and GSE LHe Cart and their holding fixture/movable dolly)
  - Receiving area: 36 ft. long, 24 ft. wide and 18 ft. high (for unpacking remainder of equipment in series)
- o Overhead crane - both in Checkout and Receiving Area (Capacity 10,000 lbs.)
- o LHe, X_e, GN_2 in Checkout area for contingency.

Support Requirements

- o Holding Fixture for MS (less HE-158), HE-158, pallet segments, two electrical GSE racks, LHe Cart, GN_2 Cart, and X_e Cart.
- o Fork lift trucks
- o Procedures for unpacking equipment and conducting post-transportation integrity inspection
- o Fork lift truck operators and inspection personnel.

Block 1.1.3.1 Transfer MS Shipping Containers from PPF to Temporary Storage Area

After the equipment is removed from the shipping containers, the containers are removed from ~~its~~ the PPF and transported to a temporary storage area. It is anticipated that the shipping containers will be re-used to return the MS to the NASA Development Center at the conclusion of the mission.

Ground and Launch Support Facility Requirements

Facility Requirements

- o Protected Storage Area (hanger-type protection satisfactory) - 60 ft. long, 50 ft. wide, and 18 ft. high (for all MS and MS GSE shipping containers).

Support Requirements

- o Fork lift truck
- o Trucks ($2\frac{1}{2}$ ton)
- o Operators for fork lift and $2\frac{1}{2}$ ton trucks
- o Inventory management

Block 1.1.4 Move HE-158, pallet segments, Electrical GSE, GN_2 Cart from Receiving Area to Checkout Area of PPF

After the above equipment has been unpacked, placed on movable fixtures/dollies and inspected, the equipment is moved to the checkout area of the PPF. Except for the pallet segment, the equipment can be moved by hand. The pallet segments will require a small tow tractor.

Ground and Launch Support Facility Requirements

Facility Requirements

- o Clear aisle from receiving area to checkout area in PPF (18 ft. wide and 10 ft. high)

Support Requirements

- o Tow tractor (for pallet segments)
- o Operator for tow tractor

Block 1.2 Mate MS (less HE-158) with Pallet Segments

The two pallet segments are joined in the pallet segment holding fixture, which is then positioned for receiving ~~its~~ the MS (less HE-158). The MS (less HE-158) is removed from its holding fixture, hoisted into the pallet segments and secured. The MS Fluid GSE carts are positioned alongside the holding fixture for servicing the MS (less HE-158) as required. Protective covers as appropriate are installed, and the MS (less HE-158) remains in the condition until transfer to the pad.

MS critical parameters are monitored continuously.

Ground and Launch Support Facility Requirements

Facility Requirements

- o PPF Checkout area. - 35 ft. long, 27 ft. wide, and 30 ft. high
- o Overhead crane (10,000 lbs. capacity)
- o LHe, X_e, and GN_2 supply for contingency
- o Electrical power - TBD

Support Requirements

- o Procedures, technicians, hardware, and tools for mating the two pallet segments and for mating the MS (less HE-158) to the joined pallet segments.
- o Operators for overhead crane
- o Procedures and technicians for servicing LHe, X_e, and GN_2 for contingency.

Block 1.3 Install HE-158 in Orbiter Simulator and Verify Interfaces

The HE-158 (Control/Display Assembly) is installed in the Orbiter Simulator, and interface connections mated. The performance of the MS (less HE-158) is simulated by the two racks of MS GSE electrical equipment. The interface verification tests involve the following interfaces:

- Interface between the HE-158 and the Orbiter Simulator
- Interface between the Orbiter Simulator and the MS GSE electrical equipment.

Block 1.3 (Continued)

It is noted that the MS (less HE-158) is not being exercised in the PPF, and that the interface verification tests are being conducted using MS GSE in place of the MS. The logic of this approach is based upon the assumption that the MS monitored parameters (continuous) reveal satisfactory operation of the MS, and the verification test is mainly to discover abnormalities across the Orbiter interface which is accomplished by using the MS GSE instead of the MS. It is further assumed that this approach does not create added GSE requirements, since these same functions would have been provided by GSE during previous development and checkout activities of the MS prior to launch site arrival.

The interface between HE-158 and Orbiter simulator are:

- o Electrical power
- o Digital down link (digital up link for ground control?)
- o Up and down links voice, for ground control

The interface between Orbiter Simulator and MS GSE are:

- o Electrical power
- o Digital commands, responses, and housekeeping data

Ground and Launch Support Facility Requirements

Facility Requirements

- o Electrical power - TBD
- o Data processing - TBD
- o PPF checkout area
  - 20 ft. long, 16 ft. wide, 18 ft. high (for Orbiter Simulator and GSE)

Block 1.3 (Continued)

Support Requirements

- o Procedures and Technicians for conducting interface verification tests
- o Procedures, hardware, tests, and technicians for installing HE-158 into Orbiter Simulator
- o Procedures, hardware, tests, and technicians for mating Orbiter Simulator and electrical GSE equipment.
- o Overhead crane and operator (2,000 lbs. capacity)
- o Workstands around Orbiter Simulator (8 ft. long, 6 ft. wide, three sides).

Block 1.4 - Disconnect HE-158 and Electrical GSE from Orbiter Simulator and Transfer from PPF to OPF

Upon completion of the interface verification tests, the HE-158 is removed from the Orbiter Simulator, and the electrical GSE is unmated from the Orbiter Simulator.

These equipments are loaded in $2\frac{1}{2}$ ton, closed body trucks, and transported to the OPF for processing with the Orbiter.

Ground and Launch Support Facility Requirements

Facility Requirements

- o Overhead crane (2,000 lbs. capacity)

Support Requirements

- o Movable dollies for HE-158 and electrical GSE
- o Procedures and technicians for removing HE-158 and unmating electrical GSE
- o $2\frac{1}{2}$ ton truck, closed body
- o Fork lift truck
- o Operators for overhead crane, $2\frac{1}{2}$ ton truck, and fork lift truck.

Block 1.5 - Move MS (less HE-158) and GSE LHe Cart to Launch Pad

Final PPS servicing is conducted on the MS (less HE-158) prior to transfer to the launch pad. This activity involves LHe, X_e, and GN_2 supply as indicated by the monitoring displays of the MS (Less HE-158).

After servicing, the GSE is disconnected, and it is assumed that the MS (less HE-158) can be transported from the PPF to the launch pad without the need of servicing enroute, although the MS parameters are monitored during the transfer to indicate any critical situation which may occur.

The pallet segments and their holding fixture are hoisted onto a flat bed trailer, and towed to launch pad.

The LHe cart, on its movable holding fixture, is transferred to the launch pad in a similar manner.

Ground and Launch Support Facility Requirements

Facility Requirements

- o LHe, X_e, and GN_2 supply for contingency
- o PPF checkout area
  - 30 ft. long, 30 ft. wide, and 20 ft. high
- o Overhead crane (12,000 lbs. capacity)

Support Requirements

- o Flat bed trailer and tow tractor
- o Procedures and technicians for servicing MS (less HE-158)
- o Procedures and riggers for loading the pallet segments and LHe cart on flat bed trailer
- o Operator for overhead crane and tow tractor
- o Traffic security personnel

3.2 Block 2.0 Activities - Orbiter/Payload Integration

The activities in this functional block begin with the arrival at the Orbiter Processing Facility (OPF) of the monitor and control equipment associated with the Magnetic Spectrometer experiment which is to be installed in the Payload Specialist Station (PSS) of the orbiter. Figure 2.2-1 graphically depicts this flow.

Block 2.1 Install Equipment in PSS

Conditions: Monitor and control assembly and associated GSE/STE have been delivered to the mating area of the OPF.

Block 2.1.1 Remove cover(s) from the Monitor and Control Assembly and associated GSE/STE.

Block 2.1.2 Verify no transport damage has been incurred (visual inspection).

Block 2.1.3 Using the GSE handling fixture carry the PSS equipment onto the orbiter.

Block 2.1.4 Emplace equipment in the PSS console. Return handling fixture to stores.

Block 2.1.5 Position the checkout GSE/STE in the payload bay adjacent to Magnetic Spectrometer/Orbiter interface connection.

Support Requirements

Facilities

Floor Space - 100 ft^2 (10 x 10)

Ground Support Equipment

Handling fixture - mission equipment

Stimuli simulator - Magnetic Spec

Stands - access (ref. only - orbiter supplied)

Logistics

Procedures

Warehousing (space TBD)

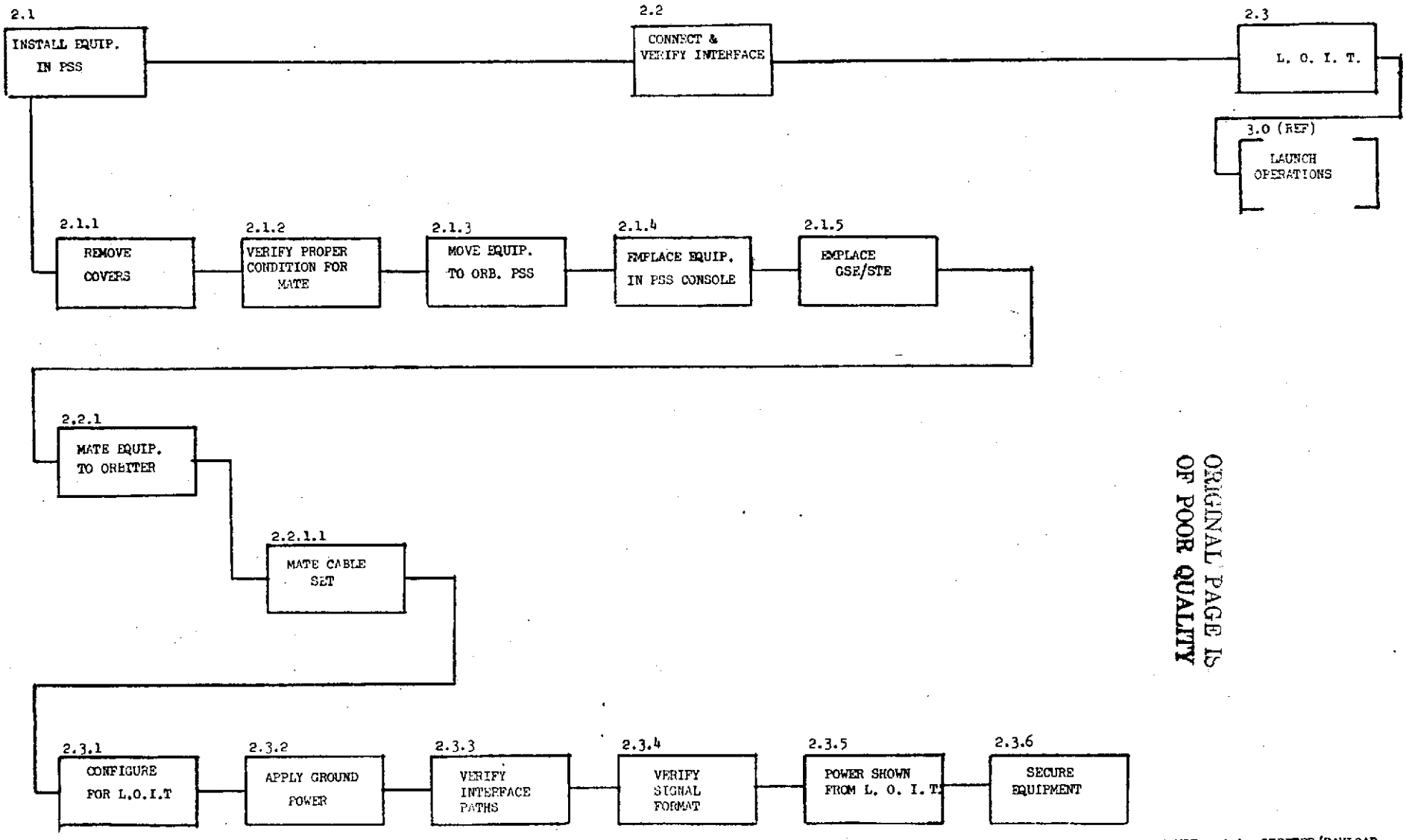


FIGURE 2.2-1 ORBITER/PAYLOAD INTEGRATION

Block 2.2 Connect and Verify Equipment Interfaces

Conditions: Equipment is in place and mechanically secure.

Block 2.2.1 Verify power off on both sides of the interface(s). When verified, mate the Monitor and Control equipment to the Orbiter connector.

NOTE: Depending on design, electrical connection may be made automatically during mechanical installation.

Block 2.2.1.1 Mate cable set between GSE/STE and experiment/orbiter interface.

Support Requirements

Facilities

No change from 2.1

Ground Support Equipment

Stimuli Simulator (in place from 2.1)

Cable Set, Simulator/Orbiter mate.

Logistics

Procedures

Block 2.3 Perform Limited Orbiter Integrate Test (LOIT)

Conditions: All interface connections have been made and verified. Orbiter support available and verified.

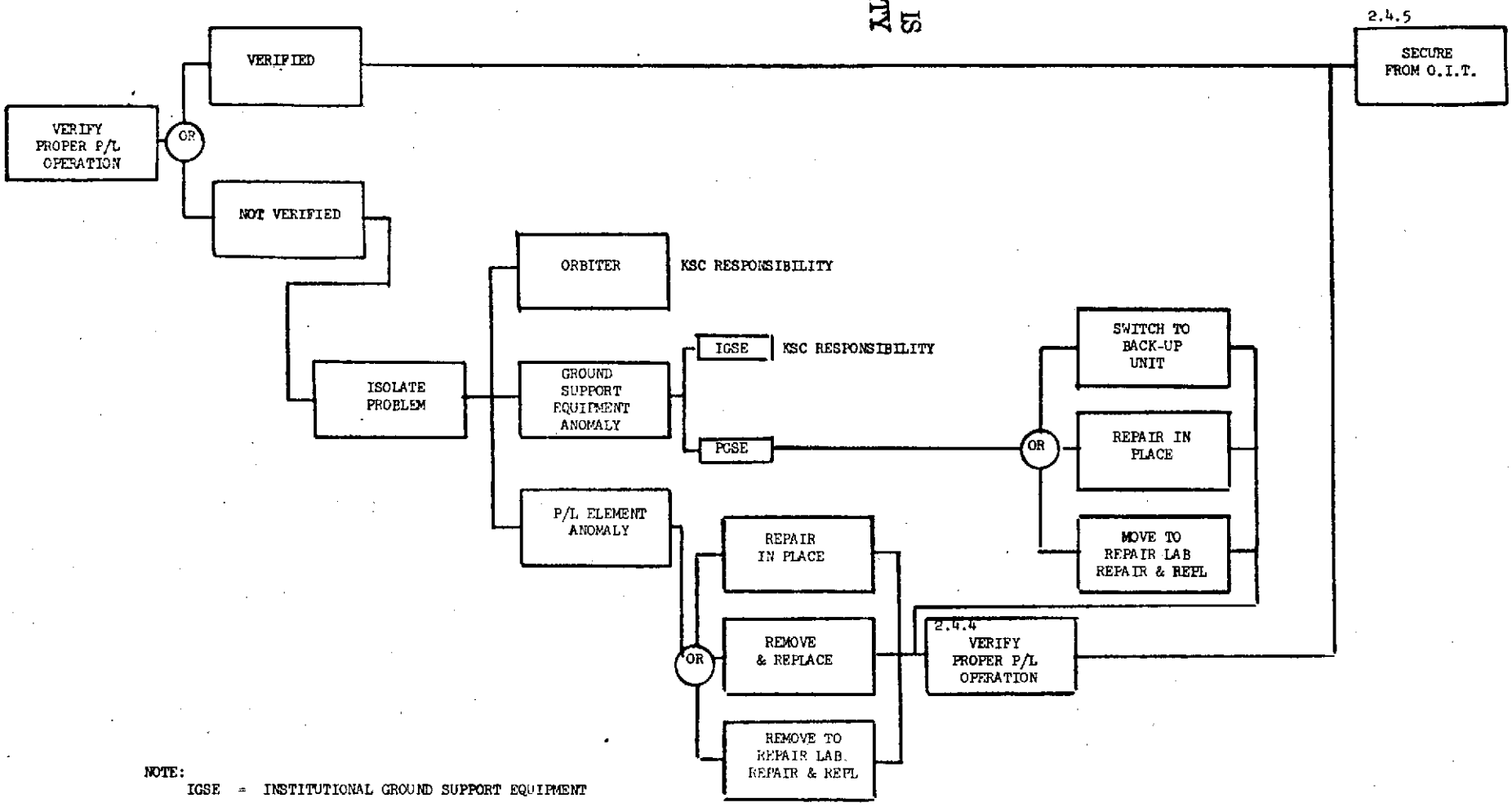
Block 2.3.1 Configure orbiter, payload, and associated GSE to support OIT position switches and circuit breakers per test procedures and verify.

Block 2.3.2 Apply ground power to the required systems and verify proper level and distribution.

Block 2.3.3 Verify functional path through Orbiter/Payload interface paths.

Block 2.3.4 Verify proper signal format and level for all operating payload elements

Block 2.3.4.1 Figure 2.2-2 is a graphis representation of a typical anomaly loop and indicates various options in effecting corrective action. Once the anomaly has been isolated, the decision on which path to follow will be a "real time" decisior



NOTE:
IGSE = INSTITUTIONAL GROUND SUPPORT EQUIPMENT
PGSE = PAYLOAD PECULIAR GROUND SUPPORT EQUIPMENT

FIGURE 2.2-2 TYPICAL ANOMALY FUNCTIONAL LOOP

Block 2.3.4.1 (continued)

based on repair requirements and/or mission criticality. It is assumed that any anomaly associated with the Orbiter or the Institutional Ground Support Equipment will be the responsibility of KSC operational personnel, while anomalies within the payload elements or Peculiar Ground Support Equipment will be corrected by the payload operations personnel.

Block 2.3.5 Upon final verifications of the correct readouts and functional interfaces, secure from O.I.T. power down active systems and position all switches and circuit breakers as called for in the O.I.T. procedures.

Block 2.3.6 Remove Stimuli Simulator and associated Cable Sets and return to storage

Support Requirements

Facilities

Add Data Processing

Ground Support Equipment

Add Ground Power - 28VDC TBD watts

Logistics

Procedures

3.3 Block 3.0 Activities - Prelaunch and Launch Operations

All payload operations covered in this Activity are mate Magnetic Spectrometer (MS) to Orbiter at the launch pad; after mate continuous monitoring, launch readiness verification checks, and payload final servicing.

Block 3.1 Mate Payload with Orbiter

After MLP arrive at launch pad, and is hardmounted, begin preparations for mating MS. The preparation include all those efforts required to physically and functionally mate the payload in the Orbiter Cargo Bay. The prerequisities of entering this block are as follows:

- o All elements requiring integration have been integrated.
- o Required GSE, STE, facility services, and personnel are available.
- o Changeout payload bay is extended.
- o Orbiter payload bay doors are open.
- o Magnetic Spectrometer in position to off-load from payload transporter.

Block 3.1.1 Lock transporter in position and remove all transport covers.

Block 3.1.2 Verify no transport damage has been incurred and payload and associated hardware is in a mate condition (visual inspection).

Block 3.1.3 With the overhead crane in position, attach the auxiliary crane controls to the hook and the hoisting GSE to the crane control. Raise the assembled functional set and attach to MS pallet hoist points.

Block 3.1.4 Using the Auxiliary Control, apply a load of TBD pounds as indicated on the dial face. Unlatch all transporter hold down points and raise MS clear of the transport unit.

Block 3.1.5 Hoist, attach to payload bay rails, and position in bay.

Block 3.1.6 Secure all payload bay latches and verify.

Facility Requirements Functional Block

- o Transporter unload area - 30' x 30'
- o Overhead Crane - 15,000#

Support Requirements

- o Hoist, Functional Set
- o Auxiliary Crane Control

Block 3.2 Connect and Verify Orbiter/Payload Interfaces

The MS is mechanically mated to the Orbiter and latch down has been verified.

Block 3.2.1 Verify power off on both sides of the electrical interface. When verified, mate the Orbiter to Payload umbilical(s).

Block 3.2.2 Disconnect hoisting handling GSE and move clear of payload bay.

Facility Requirements

- o Overhead crane - 15,000#

Support Requirements

- o None

Block 3.3 Payload Closeout

Payload has been physically and functionally mated to the Orbiter.

Block 3.3.1 Remove protective covers from the Remote Manipulator System (RMS) arms. (Reference only - not a payload function).

Block 3.3.2 Remove protective covers from the payload bay door mounted radiators. (Reference only - not a payload function).

Block 3.3.3 Remove all non-essential GSE and stow.

Facility Requirements

- o None

Support Requirements

- o None

Block 3.4 Launch Readiness Verification/Payload Monitor

The MS payload is mechanically mated to the Orbiter and latch down has been verified. The payload ground support equipment, such as LHe conditioning unit and associated hardware is in place to support the Dewar/cryostat/magnet continuous cooling requirement. At this time, the monitoring of the MS power-on system, caution and warning system, and environmental system will being and continue through lift-off. In parallel, launch verification checks will be performed on the orbiter/payload interfaces, and the payload built-in checkout and test circuits.

Block 3.4.1 Monitor Payload Status

The payload environmental control system, power system, and caution and warning system is monitored remotely until liftoff.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o TPS - CCMS
- o Power - TBD

Support Requirements

- o None

Block 3.4.1.1 Payload Status Anomaly

During this activity an anomaly could be loss of power, which would result in payload monitoring capabilities. The loss of environmental control which would affect the payload status. Lastly, an LHe problem which

Block 3.4.1.1 (Continued)

would also affect the payload status conditions.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o LPS - CCMS
- o Power - TBD

Support Requirements

- o None

Block 3.4.1.2 Isolate Anomaly

The technician monitoring payload would have to observe conditions, and try to isolate problem to a particular system.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o LPS - CCMS
- o Power - TBD

Support Requirements

- o None

Block 3.4.1.3 Troubleshoot and Repair

The technician/engineer will determine course of action to resolve anomaly and will proceed with troubleshoot and repair procedures.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o LPS - CCMS
- o Power - TBD

Support Requirements

- o None

Block 3.4.1.4 Verify System

Upon completion of repair of system, a verification test would be performed to verify system functions as required to maintain integrity of payload.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o LPS - CCMS
- o Power - TBD

Support Requirements

- o None

Block 3.4.2 Payload Status Monitoring

A continuous effort until liftoff to observe payload monitoring requirements function as required to maintain integrity of payload.

Facility Requirements

- o Power - TBD
- o Data Processing - via Orbiter Ground Link
- o LPS - CCMS

Support Requirements

- o None

Block 3.4.3 Payload Status Verification

After installation of MS, access to the Orbiter Cargo Bay and PPS to perform an orbiter to payload interface verification. The verification would check the operational capabilities of the controls and switches required to operate the payloads on-orbit.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Power - TBD
- o Monitoring LPS
- o Fluids - GN_2 LHe, X_e

Block 3.4.3 (Continued)

Support Requirements

- o None

Block 3.4.3.1 Payload Status Anomaly

During verification, an anomaly could appear which could jeopardize the mission. The anomaly could be lack of control or switches in PPS for operation of payload, or the data processing/recording system are inoperative due to interface problem or equipment failure, or loss of environmental monitor and control system. Whatever the anomaly, we would proceed to resolve anomaly prior to liftoff.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o LPS - CCMS
- o Power - TBD
- o Monitoring LPS
- o Fluids - GN_2 and LHe

Support Requirements

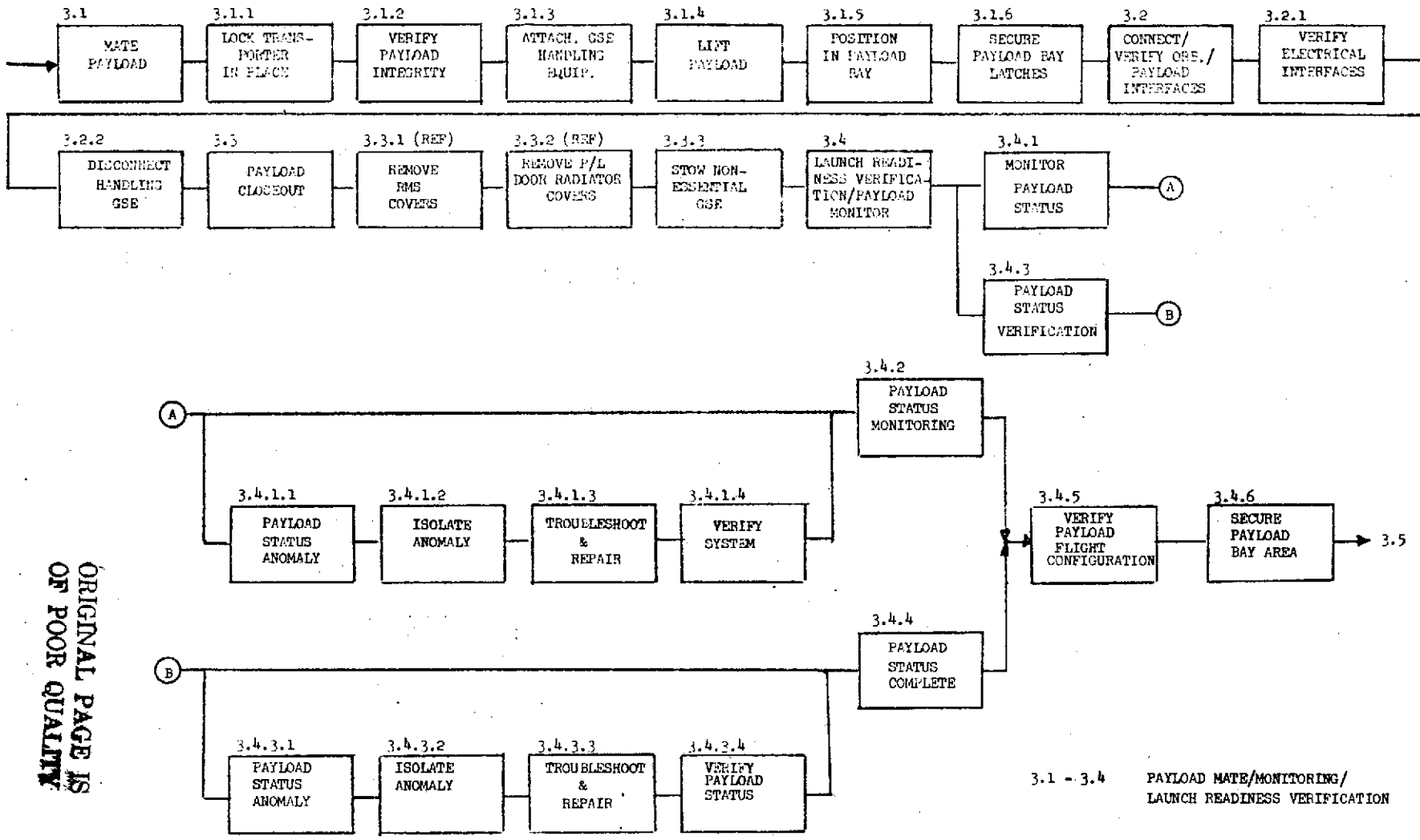
- o None

Block 3.4.3.2 Isolate Anomaly

The technicians/engineers performing the verification checks would isolate the anomaly to either Ground Support Equipment, Payload or Orbiter Systems. After the anomaly has been isolated, a typical approach to resolution of problem is shown on Figure 3.1 . The GSE/Payload - Off-line maintenance would be performed by experimenter. Orbiter Systems maintenance resolution would be KSC responsibility.

Facility Requirements

- o Data Processing - via Orbiter Ground Link



3.1 - 3.4 PAYLOAD MATE/MONITORING/ LAUNCH READINESS VERIFICATION

Fig 3.1

Block 3.4.3.2 (Continued)

Facility Requirements (Cont'd.)

- o LPS
- o Power - TBD
- o Monitoring LPS
- o Fluids - GN_2 and LHe

Support Requirements

- o None

Block 3.4.3.3 Troubleshoot and Repair

A typical approach is shown on Figure 3.1

Facility Requirements

- o Clean Lab
- o Calibration
- o Mech Lab
- o Battery and Storage Lab
- o Elect Lab

Support Requirements

- o Transportation
- o Handling Fixtures/Slings

Block 3.4.3.4 Verify Payload Status - Off-Line

After the resolution of the payload/GSE anomaly, a verification check would be made prior to installation in payload bay to show that it can now support the defined performance requirements of the mission.

Facility Requirements

- o Clean Lab
- o Calibration Lab
- o Elect Lab

Block 3.4.3.5 (Continued)

Support Requirements

- o GSE - TBD
- o Special test equipment - TBD
- o Transportation
- o Handling Fixtures/Slings

Block 3.4.4 Payload Status Verification Complete

The verification check was performed with no problems, and if an anomaly did occur it has since been resolved and the payload is ready for flight.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Power - TBD
- o Monitoring LPS - CCMS
- o Fluids - GN_2 and LHe

Block 3.4.5 Verify Payload Flight Configuration

Prior to securing OBSS and payload bay, a check is made to verify that all experiments, controls, switches, etc. are in flight readiness configuration.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Power - TBD
- o Monitoring LPS - CCMS
- o Fluids - GN_2 and LHe

Support Requirements

- o None

Block 3.4.6 Secure Payload Bay Area

Secure all PPE used in verification checks between OPSS and payload.

Block 3.4.6 (Continued)

Facility Requirements

- o None

Support Requirements

- o TBD

Block 3.5 Payload Final Servicing

During this period, the payload will be monitored, as in Activity 3.4.1 through liftoff. The payload final servicing will be top-off of LHe, purge and repressurization gas, and instrumentation gas experiment support systems. Access is required to payload bay area for final servicing and verification. After top-off, the payload/orbiter will be secured and the Orbiter Shuttle will proceed with countdown and lift-off. (Fig. 3.1)

Block 3.5.1 Verify Payload Final Servicing Req

Access is required through payload changeout room to payload bay to monitor Fluid/systems to determine if the systems need top-off.

Facility Requirements

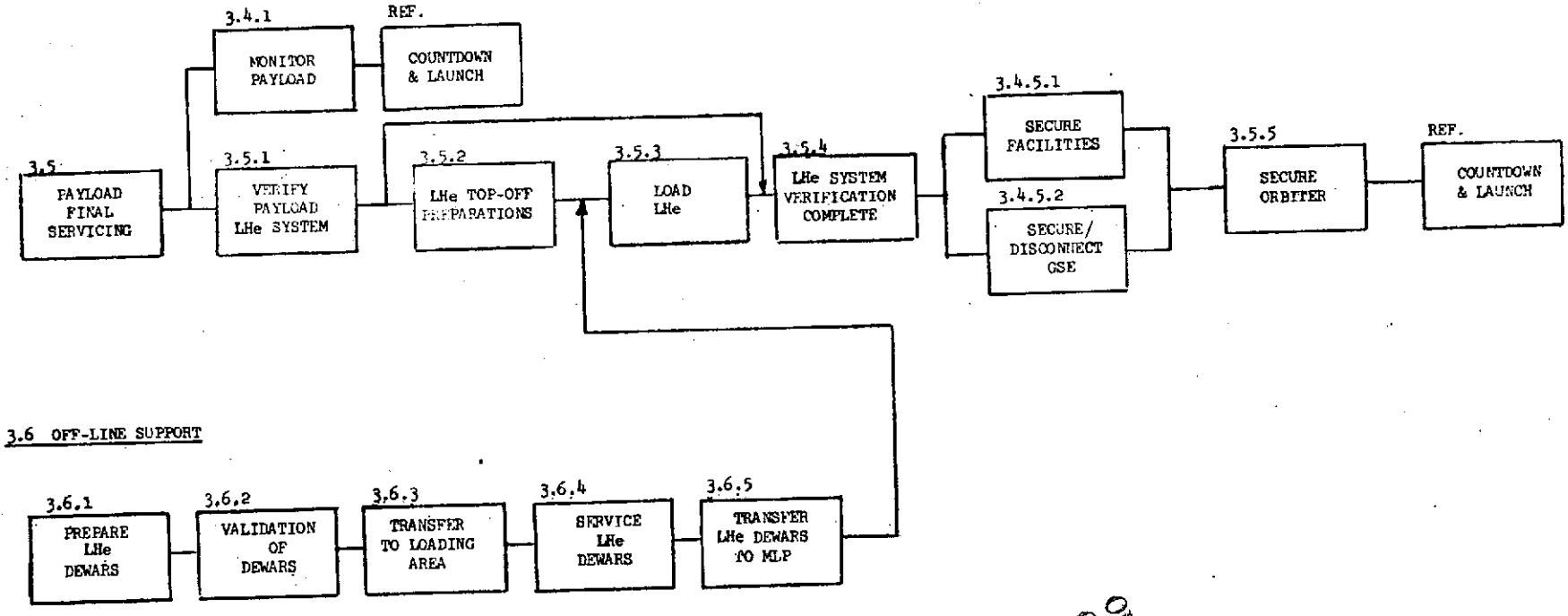
- o Fluids - LHe, GN_2, clean air, Instrument Gas
- o Power - TBD
- o Data Processing - via Orbiter Ground Link
- o Monitoring LPS

Support Requirements

- o None

Block 3.5.2 Servicing Top-Off Preparations

Install/connect GSE servicing equipment to payload in preparation for loading LHe, GN_2 and X_e.



ACTIVITY 3.5 FINAL PAYLOAD SERVICING

Fig. 3.2

Block 3.5.2 (Continued)

Facility Requirements

- o Payload Changeout Room
- o Power - TBD

Support Requirements

- o None

Block 3.5.3 Load Fluids

With the arrival of the LHe dewars, connect dewars to conditioning unit, and start chilldown. Chilldown completed load LHe to top-off payload. Top-off of other gas systems by high pressure bottles.

Facility Requirements

- o Monitoring - LPS CCMS
- o Data Processing - via Orbiter Ground Link
- o Power - TBD
- o Fluids - LHe, GN_2 and X_e

Support Requirements

- o Safety

Block 3.5.4 Final Servicing Verification Complete

The fluid system monitoring check was performed, and top-off completed if required, the payload is now ready to perform its mission in orbit.

Facility Requirements

- o Monitoring - LPS - CCMS
- o Data Processing - via Orbiter Ground Link
- o Power TBD

Support Requirements

- o None

Block 3.5.4.1 Secure Facilities

Secure all facilities on MLP in support of payload monitoring, verification checks, and servicing.

Facility Requirements

- o None

Support Requirements

- o None

Block 3.5.4.2 Secure/Disconnect GSE

Secure/disconnect all GSE on MLP, Payload Changeout Room, used in support of payload monitoring, verification checks and servicing.

Facility Requirements

- o None

Support Requirements

- o Transportation - TBD
- o Safety

Block 3.5.5 Secure Orbiter

Payload bay, payload/experiments are now completely secured and launch operations can proceed toward countdown and liftoff.

Facility Requirements

- o None

Support Requirements

- o None

Block 3.6 Off-Line Support

Off-line support is any activity required for support of verification, servicing, monitoring, etc. that will be used to support the processing of the payload through Launch Operations.

Block 3.6.1 Prepare LHe Dewars

The preparations are an off-line activity for top-off of LHe on payload during final servicing. Includes disassembly/assembly of dewars for cleaning, calibration and proofing of hoses.

Facility Requirements

- o Mech Lab with laminar flow bench
- o Clean Lab
- o Calibration Lab

Support Requirements

- o Transportaton - TBD

Block 3.6.2 Validation of Dewars

Functional test of dewars prior to servicing.

Facility Requirements

- o Mech Lab
- o Power - TBD
- o Fluids - GN_2, LHe, X_e

Support Requirements

- o None

Block 3.6.3 Transferring Dewars to Area for LHe Loading

Facility Requirements

- o None

Support Requirements

- o Transportation - TBD

Block 3.6.4 Service LHe Dewars

Configure LHe dewars, load, and verify dewars are ready to support top-off of payload experiment.

Block 3.6.4 (Continued)

Facility Requirements

- o Fluids - LHe, GN_2, X_e
- o Power - TBD

Support Requirements

- o None

Block 3.6.5 Transfer LHe Dewars to MLP

Upon completion of servicing transfer LHe dewars to MLP to support top-off of payload.

Facility Requirements

- o None

Support Requirements

- o Transportation - TBD

Block 3.7 Typical Off-line Maintenance - Payload/GSE

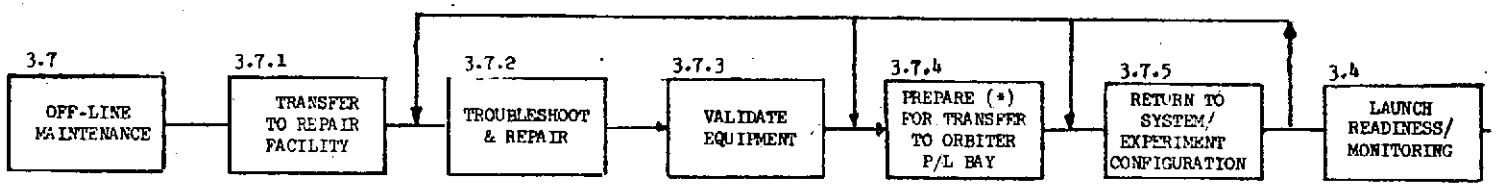
The off-line maintenance for payload, subassemblies, and GSE in direct support of the payload, and GSE in direct support of the experiment is the responsibility of the experimenters. The maintenance is performed in the support facilities, required for trouble-shooting, repair, and verification, as defined in Facilities Requirements for their particular payload/GSE. A typical off-line maintenance flow is shown in Figure 3.3

Block 3.7.1 Transfer to Repair Facility

Initial step in off-line maintenance is to transfer payload/GSE to specific facility required to support maintenance of anomaly.

Facility Requirements

- o Clean Lab
- o Calibration Lab
- o Battery and Storage Lab
- o Elect Lab
- o Mech Lab



TYPICAL EXPERIMENT/PAYLOAD/GSE - OFF-LINE MAINTENANCE FLOW

FIGURE 3.3

Block 3.7.1 (Continued)

Support Requirements

- o Transportation
- o Handling Fixtures

Block 3.7.2 Troubleshoot and Repair

Perform all steps necessary for trouble-shooting and repair of experiment/payload/GSE anomaly.

Facility Requirements

- o Cleaning Lab
- o Calibration Lab
- o Battery and Storage Lab
- o Elect Lab

Support Requirements

- o Logistics Spares

Block 3.7.3 Validate Equipment

Performance of test to verify anomaly has been repaired and payload sub-assemblies/GSE is ready to support mission.

Facility Requirements

- o Power - TBD
- o Fluids - TBD
- o Gases - TBD

Support Requirements

- o Test Equipment - TBD
- o Support GSE - TBD

Block 3.7.4 Prepare (*GSE) for Transfer to Orbiter Payload Bay

Perform all steps necessary to prepare * , payload subassemblies/GSE for transfer back to Orbiter Payload Bay, while still maintaining integrity of experiment.

Facility Requirements

- o Power - TBD
- o Fluids - TBD
- o Gas - TBD

Support Requirements

- o Transportation
- o Handling Fixtures

Block 3.7.5 Return to System/Experiment Verification

Reinstall payload assemblies, GSE back to configuration to support mission. Verify electrical/mechanical interfaces as required, and verify mission support capabilities of system.

Facility Requirements

- o Power - TBD
- o Fluids - TBD
- o Gas - TBD
- o Data Processing
- o Monitoring LPS

Support Requirements

- o TBD

Block 3.8 ~~Typical~~ - Payload/Orbiter - Maintenance ~~Flow~~

The Orbiter Support System for Payloads are Orbiter (KSC) responsibility. If an anomaly occurs between the interfaces, such as in the Data Processing

[redacted]ck 3.8 (Continued)

System or Environmental System, the appropriate Orbiter (KSC) representative would be notified and KSC would proceed with resolving anomaly. After resolution, interfaces would be verified to determine if now payload is ready to support its mission in orbit.

Facility Requirements

- o KSC Responsibility

Support Requirements

- o KSC Responsibility

3.4 Block 4.0 - Post Landing Operations

With the Orbiter hard mounted in the OPF, the Orbiter Support Systems are switched to facility services and preparation for safing and removal of payload elements begins. Safing completed, the GSE processing for removal of payload doors and payload proceed until the payloads are securely mounted on transporters and are transported to the Payload Post-Mission Processing Area. (Fig 4.1)

Block 4.1 Switch to Facility Services and Safe Payload

The Orbiter Support Systems are switched to facility services; such as, power, cooling and instrumentation. Purge and Dry Payload elements (as applicable) commences until payload is environmentally safe for personnel access. The switch over to Payload Ground Monitoring is also verified during this activity.

Block 4.1.1 Payload Support System Verification

The payload bay area has been purged and the change over to facilities for power, cooling, instrumentation for ground monitoring has been completed and verified operational.

Facility Requirements

- Power - TBD
- Fluids - GN_2, LHe

Support Requirements

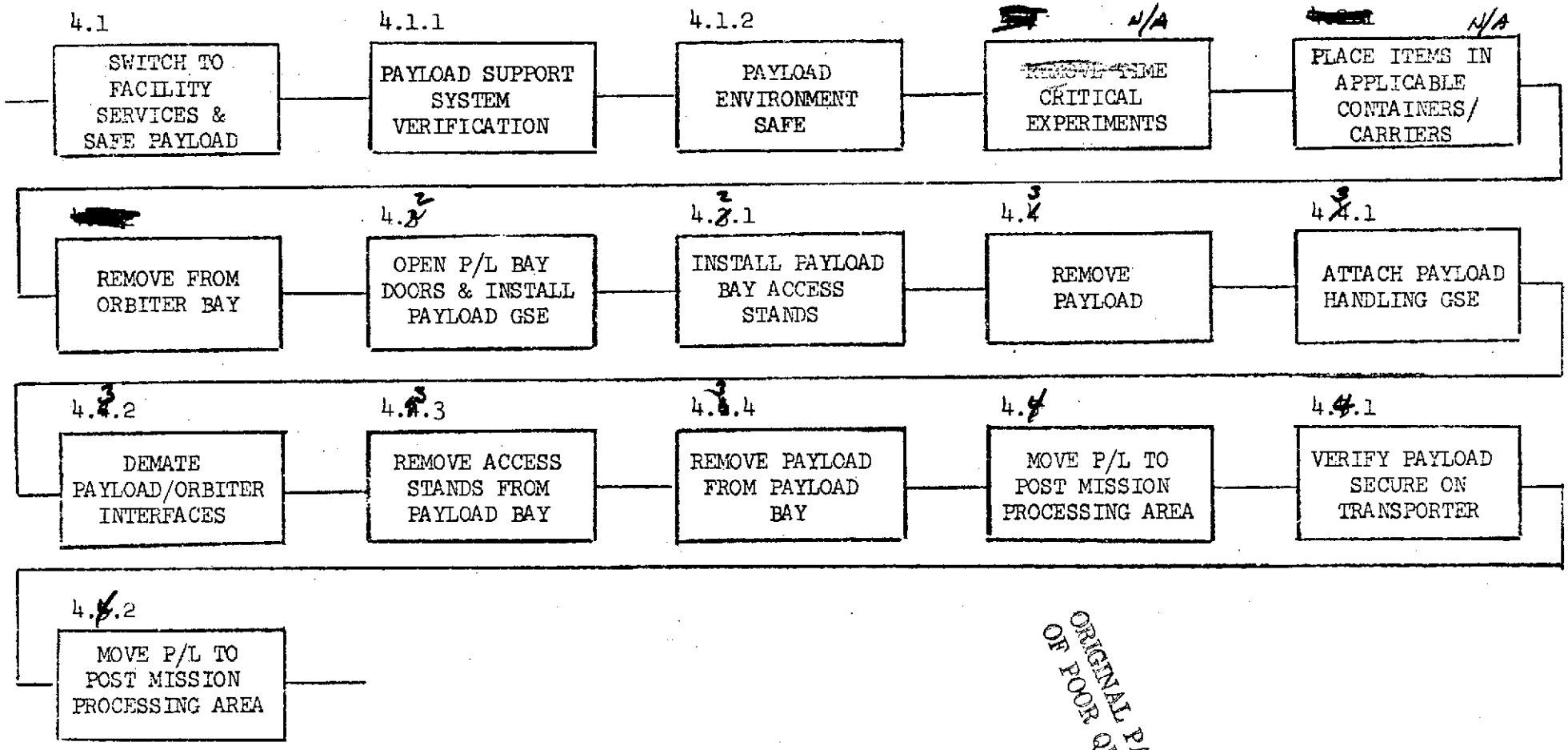
- None

Block 4.1.2 Payload Environment Safe

A verification by safety that the payload area is environmental safe for personnel access, including unexpelled ordnance removal complete.

Facility Requirements

- Power - TBD



4.0 POST LANDING OPERATIONS

Fig 4.1

Block 4.1.2 (Cont'd.)

Support Requirements

- o Ordnance Area
- o Safety

Block 4.2 Open Payload Bay Doors and Install Payload GSE

After the thermal protection system, the Paylaod Bay Doors are removed and the manipulator arm deployed, the experimenter is responsible for installation of payload bay access stands.

Block 4.2.1 Install Payload Bay Access Stands

The experimenter installs payload access stands as required for removal of payload from Orbiter Payload Bay.

Facility Requirements

- o Power - TBD

Support Requirements

- o None

Block 4.3 Remove Payload

The removal of Payload includes all the tasks; such as, attaching payload handling GSE, demating of the Payload/Orbiter interfaces, the removal of access stands, and finally the removal from payload bay and placement on payload transporter/handling fixture.

Block 4.3.1 Attach Payload Handling GSE

The Payload Handling GSE; such as, slings are now moved into place and connected to lifting points on payload.

Facility Requirements

- o Power - TBD
- o Crane - 15,000 lbs. capability

Support Requirements

- o None

Block 4.3.2 Demate Payload/Orbiter Interfaces

The Payload/Orbiter Interfaces are disconnected and the payloads are inspected for approval for removal from Orbiter.

Facility Requirements

- Power - TBD
- Crane - 15,000 lbs.

Support Requirements

- None

Block 4.3.3 Remove Access Stands from Payload Bay

The experimenters remove the access stands in order to clear the payload bay area for removal of payload.

Facility Requirements

- None

Support Requirements

- None

Block 4.3.4 Remove Payload from Payload Bay

The Payload is lifted from the payload bay and installed/mounted on the payload transporter/handling fixture.

Facility Requirements

- Power - TBD
- Crane - 15,000 lbs.

Support Requirements

- Aux Equip - Environmental Control - TBD
- Safety
- Purge and Pressure Cart (GN_2)
- LHe Dewar & Conditioning Equipment

Block 4.4 Move Payload to Post Mission Processing Area

After payload is installed/mounted on transporter, verify payload monitoring system is operational, and connect LHe Dewar/Conditioning.

Block 4.4 (Continued)

equipment to payload. Service if required. Verify payload is secure and proceed with transfer to Post Mission Processing Area.

Block 4.4.1 Verify Payload Secure on Transporter

Experimenter verifies payload monitoring system is operational, and payload is securely mounted on transporter. Service LHe, if required.

Facility Requirements

- Crane - 15,000 lbs.
- Power - TBD

Support Requirements

- Purge and Pressure Cart (GN_2)
- Dewar/Conditioning Unit (LHe)
- Aux Equip - Environmental Control - TBD
- Safety

Block 4.4.2 Move Payload to Post Mission Processing Area

With payload secure in transporter, proceed to Post Mission Processing Area.

Facility Requirement

- None

Support Requirements

- Transportation - Tractor
- Security
- Safety
- Aux Equipment - Environmental Control - TBD

3.5 Block 5.0 Activities - Post Mission Processing

The activities contained within this functional block deal with the processing required following flight and prepares the various payload elements for refurbishment.

Two cases are contained in this function as is shwon in Figure 2.5-1. The following assumptions were made in defining tasks within this function:

- o Vehicle has been safed and verified.
- o All pressures have been vented to nominal values.
- o All lines have been purged, padded, and capped.
- o All exposed electrical connectors have been capped.
- o Cryo temperature in dewar is steady.
- o All other activity in Functional Block 4.0 has been completed.

Block 5.1 Inspect Payload

Conditions: The pallet mounted magnetic spectrometer has been delivered to the Premission Processing Facility and wiped down in the airlock.

Block 5.1.1 Position payload elements and access GSE in the proper area.

Block 5.1.2 Remove all protective covers and/or panels to gain visual access to all payload elements.

Block 5.1.3 Visually inspect all payload elements for physical damage and document and discrepancy.

Block 5.1.4 Remove any remaining flight data and deliver to the proper agency.

Block 5.1.5 Clean payload elements as required.

Support Requirements

Facilities

Floor Space 1485 ft^2 (45' x 33')

Ground Support Equipment

Access stands - set

Handling equipment - covers

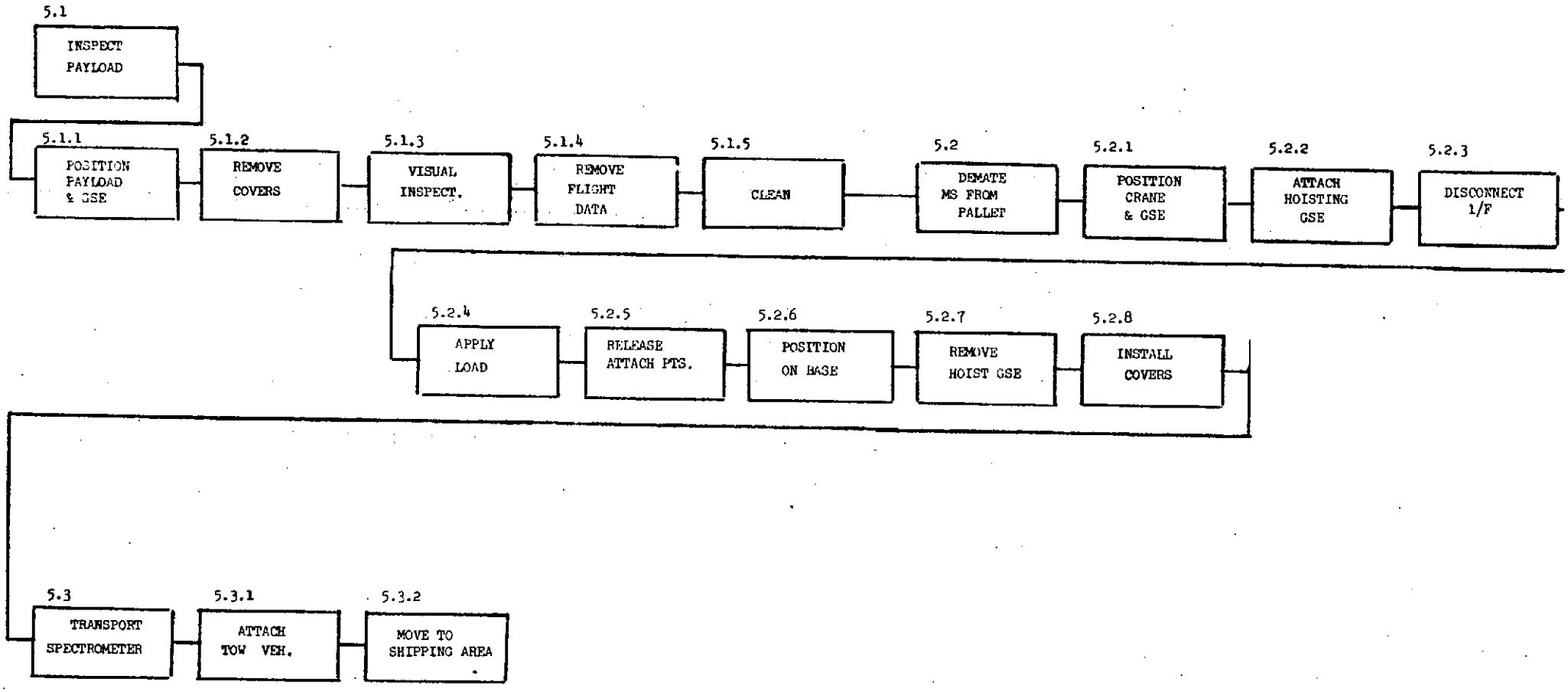


FIGURE 2.5-1 POST MISSION OPERATIONS

Block 5.1.5 (Cont'd.)

Support Requirements

Ground Support Equipment (continued)

LHe monitoring station set

LHe servicing set

Support

N/A

Logistics

Procedures

Block 5.2 Demate Magnetic Spectrometer from Pallet

Block 5.2.1 Position O/H crane and attach auxiliary crane control. Attach hoisting GSE to control.

Block 5.2.2 Position crane over Magnetic Spectrometer, lower, and attach hoisting GSE to hoist points.

Block 5.2.3 Break all experiment/pallet interface connection cap all open ports and connectors.

Block 5.2.4 Using the auxiliary crane control apply a load of TBD pounds as indicated on the dial face.

Block 5.2.5 Release mechanical attachments between pallet and Spectrometer.

Block 5.2.6 Hoist clear of pallet position on shipping container base. Secure to base.

Block 5.2.7 Release hoisting GSE, lower to floor, remove GSE from crane hook and return to storage.

Block 5.2.8 Install cover(s) over Spectrometer. Verify all monitoring devices operational.

Support Requirements

Facilities

Floor space - same as 5.1

Block 5.2.8 (Continued)

Support Requirements

Facilities (continued)

O/H crane 5 ton capacity

hook height = 25'

Ground Support Equipment

Same as 5.1 plus

Hoisting slings - experiment

Auxiliary crane control

Shipping container - Magnetic

Spectrometer

Support

Crane operator

Logistics

Procedures

Block 5.3 Transport Magnetic Spectrometer

Block 5.3.1 Move tow vehicle into position and attach to containerized Magnetic Spectrometer. (Assumes container base is on rolling gear on arrival).

Block 5.3.2 Move to shipping area, load on transport vehicle and tie down. Reverify all monitoring and reservicing devices operational.

Support Requirements

Facilities

Floor space - same as 5.1

Prime mover (tow vehicle)

Ground Support Equipment

LHe monitoring equipment - transport

LHe servicing set - transport

Tie down equipment

Support Requirements (continued)

Support

Operator - prime mover

Logistics

Procedures

Transportation

NOTE: Pallet/pallet sections will be retained and refurbished and required at the launch site.

4.0 Evaluation of Information on Data Sheet (Functional) (Revision A, Dated 8/31/74)

The launch site processing upon which the requirements are listed in the Data Sheet (Functional) is the baseline flow for the launch site. The Study recommends a revised flow, and the Study-generated requirements are based upon the revised flow, therefore a comparison of the Data Sheet (Functional) information and the Study requirements is not appropriate.

The evaluation contained in the following paragraphs discuss Data Sheet (Functional) information which appear inconsistent with the baseline flow and Level B data definition.

4.1 Activity 1.0 - Payload Premission Processing

Block 1.3 Liaison Pallet Verification

A. Experiment/Payload Area Requirements

Length (FT) - 20; Comment: The 20 ft. length requirement is constant throughout Activity 1.0 processing, and it appears too short. Level B data indicates a pallet length of 15.09 ft. (which is inconsistent with standard Spacelab pallet segments of 10 ft). Noting that work stands, GSE, and aisle space is needed around the MS, it would appear that a figure of 40 ft. in length would be more appropriate.

Width (FT) - 20; Comment: The 20 ft. width is constant, and appears too little. The pallet is 15 ft. wide, and work stands, GSE, and aisle space is needed, so the figure of 40 ft. in width seems appropriate.

Temp (°K) - 263 to 303 (14°F to 86°F) which is the temperature range listed for all Activity 1.0 processing. Comment: Level B data lists the following:

- Data Sheet #S-24 (Ground Environmental Limits): Min temperature for MS assemblies range from -80°F to 40°F. Max temperature range from 79°F to 200°F.

Block 1.3 (Continued)

It is recommended that Level B data be investigated towards establishing limits of 72°F (±10) which is the anticipated temperature range of the PPF.

Relative Humidity (%) - less than 40. Comment: Data Sheet #S-24 lists max as ranging from 20 to 50 for various MS assemblies. It is recommended that these requirements be investigated towards establishing limits as 50% (±10) which is the anticipated range in the PPF.

Block 1.8 Receiving & Inspection

A. Experiment/Payload Area Requirements

Min Height (FT) - 60; Comment: In the stowed position, the MS is about 11.2 ft. high. Assuming its shipping container is 15 ft. high, and that a hoisting sling is 6 ft., and allow 6 ft. clearance, then the height requirement totals 38 to 40 ft.

It is noted that Data Sheet #S-23a and b (Ground Facility Requirements) lists min height as 19 meters (62.32 ft.), but this requirement is not understood by the Study.

B. Special Handling

Data sheet lists a requirement for a 35,000 lbs. crane. Comment: Fully loaded, the MS (less HE-158) weights 8,680 lbs. (The HE-158 weighs 132 lbs). Assume the shipping container weighs 2,000 lbs, then the total weight is about 10,800 lbs. The derivation of the 35,000 lbs. ~~The derivation of the 35,000 lbs.~~ Capacity crane is not understood.

Block 1.11 - Mate Pallet, Reassemble, and Checkout

A. AC Power - Vac = 115, Hertz = 60; Phase = single, Power (KW) = 60, with Note 3 stating continuous power of 7 KW and Note 4 indicating power required for payload GSE, typical all operations. Comment: The power requirement of 60 KW for MS GSE appears to be too large. The highest power requirement

Block 1.11 (Continued)

involves the GSE LHe Cart, and the experience on LM indicates that this unit draws around 5,000 to 6,000 watts, with most of this amount for the vacuum pumps to evacuate the vacuum-jacketed lines.

Block 1.14 Service Non-Time Critical Items

A. Data Sheet (Functional) lists:

- o For top-off contingency, supply 220 lbs. of LHe and 440 lbs. of GN_2.

  Comment: The MS capacity is 946 lbs. of LHe and 220 lbs. of GN_2. Until the loss rate is defined in level B data, the quantity of re-supply is TBD.

- o X_e requirement is listed as 440 lbs, with Note 4 indicating that X_e bottles will be filled prior to leaving MSOB. Comment: MS capacity of X_e is listed as 370 lbs. (Data Sheet #S-17).

- o Air at 3500 psig is listed as a requirement. Comment: This item cannot be identified from Level B data as a requirement for this activity. (Clean Air listed as a requirement at pad twelve hours prior launch for top-off purge and repressurzation - Data Sheet #S-22).

LAUNCH SITE FACILITY REQUIREMENTS (FUNCTIONAL)

MAGNETIC SPECTROMETER (NORMAL FLOW)

4.2 Block 2.0 activities - Orbiter/Payload Integration and Checkout

Block 2.0 Area requirements (20'l x 20'w x 60'h)

Level 'B' data gives the pallet mounted Spectrometer as being 4.58m or 15' in length, the pallet, from the ERNO description book is shown as being 4m or 13' wide. Using the dimensions on the data sheets, insufficient room for work stands and access would remain. The GAC recommendation would allow for 4' wide work stands and 6' wide aisles; additionally a 10' wide space for benches, roll arounds etc. would be provided the resultant, foot-print would become 45'l x 33'w x 60'h.

Temperature requirements (263 to 303°K)

This temperature level cannot be an area requirement since it equates to a range of from 14°F to 86°F. The recommended range is 295°K±1°K for working comfort.

Humidity requirement (40%)

Level 'B' data sheet S-9 lists humidity requirements ranging from 20% R.H. to 50% R.H. it is not obvious whether this refers to internal conditions or the ambient environment. Assuming this to be an internal condition, it is recommended that the requirement be relaxed to read 50 ± 10% RH.

Cleanliness Class (100,000)

Cleanlines class 100,000 is logical for this function; however note  calling for a continuous purge in the cargo bay is not appropriate until the doors are closed and sealed during function 2.4.

Fluid media (N/A)

With the requirement to maintain the cryogenic temperature in the cryostat dewar, a source of LHe for possible reservicing is required.

Power Requirements

No recommended changes.

Block 2.0 (Continued)

Special Handling (40,000 lb. Crane)

Payload weight, from level 'B' data sheet S-8 is given as 4003 kg the pallet weight, taken from the ERNO description book is 1740 kg for a total of 5743 kg or 12,664 lbs. Adding the SMS weight of 760.81 kg or 1678 lbs. gives a combined weight of 14,342 lbs. requiring an 8 ton crane.

No other recommended changes.

4.3 Block 3.0 Activities - Prelaunch and Launch Operations

Block 3.1 Monitor Payload thru VAB and to Launch Pad.

A. Fluids

(LHe, GN_2, X_e, Air)

(Contingency Top-off Facilities at VAB and Pad)

Due to the nature of this activity, which covers payload processing from OPF to FAB, and move to PAD , it is impossible even on a contingency basis to top-off fluids. The only time that fluids can be topped-off is when the payload is at the launch pad. Based on the fact that facilities requirements cannot be met until payload is at pad, GAC recommended that payload be stacked/mated to Orbiter at pad. At that time payload monitoring would commence and continue through lift off.

Block 3.2 Launch Readiness Verification/Access to C bin

Payload Area Requirements

(Length - N/A, Width - N/A, Min. Height - N/A)

During this activity, area should be specified for GSE servicing equipment, such as LHe conditioning unit and LHe dewars. A minimum of 8'L x 8'W. The min. height (ft) requirement, which normally is noted during payload movements, is determined by the design criteria for the payload changeout room.

Block 3.3 Payload Final Servicing:

Payload Area Requirements

(Length - N/A, Width - N/A, Min. Height - N/A)

Same as Activity 3.2

4.4 Block 4.0 activities - Post Landing Operations

Landing Crew egress and attach ground power

A. Payload Area Requirements

(Temp - 263 to 303°K)

During this period, the payload environment is supplied by the Orbiter, therefore the block should be N/A since it is not a requirement for facilities.

Block 4.3 Open Payload Bay Doors and Install Payload GSE.

A. Fluids
(GN_2)

Per level B data sheets, Ground Facility Requirements the 15,000 Kg Crane/transport must be cryogenically cooled continuously during times at launch and landing sites. Therefore LHe should be added to facility requirements data sheets, with parameters (TBD).

B. Power
(AC-115V, 60 HZ, 1 PH, 10 KW)

The power requirement specified appear to only for the external monitoring equipment. Consideration should be given to power requirements for GSE, such as LHe Conditioning Unit and dewars, if cooling is a hard requirement.

Block 4.4 Remove Payload

Payload Area Requirements
(L-20', W-20', H-60')

In order to support this activity, area should be defined for access stands, GSE servicing equipment, etc. An area approximately L-45 ft, W-35 ft, Height - 50 ft. is required.

Block 4.4 (Continued)

Special Handling

(40,000 overhead crane-transport)

Total weight of MS and pallet is 12,663 lbs. Add 1000# for handling equipment - Total payload weight 13,663 lbs. Overhead crane requirements could be 30,000 lbs. minimum.

LAUNCH SITE FACILITY REQUIREMENTS (FUNCTIONAL)

MAGNETIC SPECTROMETER

4.5 Block 5.0 Activities - Post Mission Processing

5.1 - 5.5 Area Requirements (20' x 20' x 60) & (20' x 20' x 19)

Per Level B data sheets, the Magnetic Spectrometer's dimensions are stated at 3.6 x 2.54 meters (11.81 x 8.33 ft.) the area of 20 x 20 ft. would provide insufficient room for access or movement. Access area required to perform this activity should be a minimum of 40 x 30 ft. The hook height of 19 ft. would fulfill requirements.

The stated temperature of 263-303°K (14-86°F) should be changed to 295°K ±1°K (75°F).

Crane capability could be reduced from 35,000 lb. to 10,000 lb.

There are no other recommended changes.

5.0 Evaluation of Information on Data Sheet (Physical) (Revision A, dated 8/31/74)

The launch site processing upon which the requirements are listed in the Data Sheet (Physical) is the baseline flow for the launch site. The Study recommends a revised flow, and the Study-generated requirements are based upon the revised flow, therefore a comparison of the Data Sheet (Physical) information and the Study requirements is not appropriate.

The evaluation contained in the following paragraphs discuss Data Sheet (Physical) information which appear inconsistent with the baseline flow and Level B data definition.

5.1 Activity 1.0 - Premission Processing

A. Storage Area

AREA (FT^2) - 500 is listed; comment: Study feels that storage of the MS at the launch site is inappropriate due to the MS requirement for constant cooling and monitoring. Storage of shipping containers after equipment removal is a requirement, with dimensions being:

60 ft. long, 50 ft. wide, and 18 ft. high
for all MS and MS GSE shipping containers
(3000 sq. ft., 18 ft. high)

TEMP (°K)	RELATIVE HUMIDITY (%)	CLEANLINESS CLASS
263-303	less than 40	100,000

Comment: Study identifies no requirement for these parameters.

B. Maintenance and Repair

CALIB LAB - A requirement for use is indicated. Comment: Data Sheet #S-23a (Ground Facility Requirements) lists several calibration tests and includes a note that experiment may require calibration at the National Accelerator Laboratory. The Study assumes the several calibration tests are Level III Type integration which, by groundrule, is not performed at

5.1 (Continued)

the launch site, and if required, the calibration of the MS at the National Accelerator Laboratory would be performed prior launch site arrival.

5.2 Block 2.0 Activities - Orbiter/Payload Integration and Checkout

Storage Area 500 ft^2

No storage function exists within this block; therefore, no requirement exists.

Since an anomaly may be discovered any time during this function, all labs and repair facilities should remain available on a contingency basis.

No other recommended changes.

LAUNCH SITE FACILITY REQUIREMENTS DATA SHEET (PHYSICAL)

MAGNETIC SPECTROMETER (HE-15-S)

5.3 Block 3.0 Activities - Prelaunch and Launch Operations

A. Storage Area

(Area - 500 sq. ft.)

(Temp - 263 to 303°K)

(Rel. Humid - 40%)

(Clean Class - 100,000)

Storage facilities are not required in the payload processing area for Activity 3.0 Storage requirements are defined in functional activities 1.0.

B. Maintenance and Repair

(Machine Shop - contingency only)

(Mech. lab - contingency only)

(Elect. lab - contingency only)

On a contingency basis, the Magnetic Spectrometer should have the capabilities to perform any maintenance, repair, servicing, and checkout to support the launch mission. Although the requirement is on a contingency basis, the following functional facility requirements should be considered as part of the physical requirements. Specifically for support of servicing LHe dewars, which are required continuously during processing flow at KSC.

Power - TBD

Fluids - GN_2, LHe

Data Processing - TBD

GSE - TBD

LAUNCH SITE FACILITY REQUIREMENTS DATA SHEET (PHYSICAL)

MAGNETIC SPECTROMETER (HE-15-S)

5.4 Block 4.0 Activities - Post Landing Operations

A. Storage Area

(Area - 500 sq. ft.)

(Temp - 263 to 303°K)

(Rel. Humid - 40%)

(Clean Class - 100,000)

Storage facilities are not required in the payload processing area for Activity 4.0. Storage requirements are defined in functional activities 1.0.

B. Maintenance and Repair

(Machine Shop - contingency only)

(Mech. lab - contingency only)

(Elect. lab - contingency only)

On a contingency basis, the Magnetic Spectrometer should have the capabilities to perform any maintenance, repair, servicing, and checkout to support the launch mission. Although the requirement is on a contingency basis, the following functional facility requirements should be considered as part of the physical requirements. Specifically for support of servicing LHe dewars, which are required continuously during processing flow at KSC.

Power - TBD

Fluids - GN_2, LHe

Data Processing - TBD

GSE - TBD

5.5 Block 5.0 activities - Post Mission Processing Storage Area (500 sq. ft.)

Since no storage functions occur in this block, no storage requirements exist.

There are no other recommended changes.